Latin America and Caribbean Outlook Fora, Applications Workshops,

A total of five separate Climate Outlook Fora were held in Latin America and the Caribbean during 1997-98, covering the regions of Pacific South America, Southeast South America, Northeast South America, Mesoamerica, and the Caribbean. In addition to the Outlook Fora, a unique methodology evolved in the region to facilitate interaction between the producers and users of climate information. In three of the subregions (Pacific, Southeast, and Northeast South America), formal conferences and applications workshops, in part made possible by ongoing multi-sectoral pilot applications projects, were held in conjunction with the Climate Outlook Fora. The Outlook itself was presented to the participants and used as a venue for advancing discussions on the use of climate information. Following the Caribbean event, a round-table discussion on natural-disaster preparedness was held in place of an applications workshop. Due to the success of the 1997-98 Outlook Fora, many of the subregions have continued with consensus forecasting activities, indicating the potential for development of forecast networks in these areas.

Climate impacts associated with El Niño vary greatly with space and time in the Americas. Thus the regional Outlook Fora needed to cover several different regions during different seasons.

For example, much of northwestern South America suffered severe flooding during January-March 1998, whereas many parts of Central America were extremely dry from April through June. NOAA-OGP's partners in the Americas also span many countries, with organizations such as the Inter-American Institute for Global Change Research (IAI) covering all of the Américas, and Centro del Agua del Trópico Húmedo para América Latina y el Caribe (CATHALAC) covering Mesoamerica and the Caribbean. Working with these organizations and others like them made it possible to address climate impacts in several critical areas.

Products from the Latin America and Caribbean Outlook Fora follow in the next several pages. Maps of forecast precipitation are given for:

- Pacific South America, December 1997-March 1998
- Southeastern South America, January-March 1998
- Northeastern South America, February-May 1998
- Mesoamerica, June-August 1998
- Caribbean, June-August 1998

Descriptions for each map are included, each of which outline the general methodology for producing the Outlook, a brief summary of the forecast conditions, and the participating organizations. Also included are estimated precipitation amounts for the forecast period, expressed in terms of percentage of normal rainfall. Aqualitative comparison of each Climate Outlook and estimated precipitation amounts is given in the following pages.

Pacific South America - October 1997

The Pacific South America Climate Outlook Forum was held in Lima, Peru, October 1997, in conjunction with a Pilot Applications Design Workshop and a conference on the 1997-98 El Niño entitled, "Is this El Niño of the Century? Impacts and Potential Applications of Forecast Information." The event was locally organized by the Geophysical Institute of Peru, the Peruvian Institute of Fisheries Investigations, and Sealand Advisory Services, Inc. Convened to assess and communicate the impacts of the 1997-98 El Niño event, the Climate Outlook Forum produced a consensus probabilistic precipitation Outlook for Bolivia, Chile, Colombia, Ecuador, and Peru. Participants in the Outlook creation included climate scientists from regional research organizations such as the IAI, national research institutions, National Meteorological and Hydrological Services (NMHS), IRI, and WMO.

Pilot Applications Design Workshop

Drawing on the Climate Outlook Forum, the Pilot Applications Design Workshop was held to create climate forecast applications projects tailored for climate-sensitive sectors. Utilizing the

consensus diagnostic and forecast products generated by the Climate Outlook Forum, participants discussed identifiable and potential socio-economic impacts and determined potential activities to advance additional understanding of ENSO and its implications. Participants in the Design Workshop included climate researchers (from the Climate Outlook Forum), forecast applications researchers, and potential users of the forecast information. Working groups were created based on the degree of ENSO's impact in particular sectors of the region's economy, including fisheries and aquaculture, water resources, agriculture, and health/natural disaster preparedness.

Since the 1997-98 ENSO event was successfully forecast by scientists, an opportunity existed for the fisheries sector to mitigate the potential damage caused by El Niño, and to take advantage of its possible benefits. As a result of past and current ENSO impacts, the establishment of "vedas" — or fishing season closures — has been considered in Ecuador, Peru, and Chile. In some cases, such as Ecuador, the aquaculture sector informs users about ENSO development. This occurs in two ways: 1) monthly and biweekly reports for shrimp hatchery management (assessment of the use of this information is underway); and 2) in situ conferences/workshops about ENSO in different shrimp farm regions.

The majority of fisheries working group participants believed that local coastal and near coastal information produced by forecast models is not adequate at this time. The models are useful for the macro-scale aspects of climate events, but the development of coastal or near-coastal models that use global model results as input is necessary. While potential impacts are known from previous ENSO events, only a few groups within the fisheries sector took measures to prepare for the 1997-98 El Niño; this may be due to the fact that the degree to which the event would affect fisheries was not well known. In order to advance the use of available information and set directions for future research, it is important to conduct social science studies to evaluate how useful the climate information was during 1997-98. Two efforts of this type are currently underway related to shrimp hatcheries in Ecuador and ENSO effects on artisanal fisheries.

Conference on the 1997-1998 El Niño

In addition to the Climate Outlook Forum and Pilot Applications Design Workshop, a conference on the 1997-98 El Niño was held to educate representatives of government, industry, media, and the general public about El Niño-related climate conditions, possible impacts, and methodologies to utilize climate information. The meeting consisted of a series of panels composed of experts in climate, ENSO impacts, and forecast applications (from the Outlook Forum and Applications Workshop) that interacted with participants from climate-sensitive sectors. It provided participants an opportunity to ask questions about climate-forecast products and plans to use this information for decision making in sectors such as agriculture, water resources, human health, and natural-disaster management. The conference began a dialogue between climate scientists and potential users of forecast information, with the ultimate goal being the production and refinement of best available climate forecasts with respect to user needs.

Outlook evaluation[23]

The Outlook for Pacific South America indicated there was an increased likelihood of below-normal rainfall in Columbia from December 1997 to March 1998. This was corroborated by unusually-low rainfall amounts in northern Columbia, but southwest Columbia was wetter than normal during this time. Forecasts of 60 to 80% likelihood for above-normal rainfall in western Ecuador and portions of northwest Peru matched very high precipitation totals (200-300% of normal), but the remainder of northwest Peru, forecast as climatology or a increased chance of below-normal rainfall,

[23] For a description of the qualitative method used to evaluate the Outlook, see "Comparison of Climate Outlooks and Observations" in the Methodology section.

actually had above-normal rainfall. A forecast of above-normal rainfall for a small portion of southern Chile was inconsistent with unusually-low rainfall there, while below-normal precipitation in southern Peru and southeastern Bolivia generally matched projected conditions. Eastern Bolivia was drier-than-normal from December 1997 to March 1998, inconsistent with the Climate Outlook (although drier-than-normal conditions were forecast at a 20% probability).

Climate Outlook - Rainfall

Statement from the Pacific South America Climate Outlook Forum
October 28, 1997, Lima, Peru

THE OUTLOOK FORUM

AClimate Outlook Forum was convened on October 28, 1997, to formulate consensus assessment for the summer season in Pacific South America. The forum was comprised of representatives of Meteorological Services and climate researchers from universities and international research institutes. These specialists reviewed the state of the global climate system and its implications for Pacific South America. One of the principal factors taken into account is the strong El Niño event currently underway in the tropical Pacific Ocean. Recent El Niño events resulted in extreme rainfall in some regions of Pacific South America and extreme dry conditions in other regions.

Participants at the Forum included representatives of Meteorological Services of several countries of the region (Bolivia, Chile, Colombia, and Ecuador) and climate scientists and other experts from national, regional and international institutes (Universidad Nacional de Colombia, Universidad de Chile, University of Washington, Instituto del Mar del Peru (IMARPE), IGP, INPESCA, Direccion de Hidrografia y Navigacion de la Marina (HIRDRONAV), NOAA-OGP, NOAA-NCEP, IRI, and IAI).

METHODOLOGY

This regional climate assessment began with consensus that the current strong El Niño event will remain strong over the forecast period (December 1997 - March 1998). The Sea-Surface-Temperature (SST) forecast and other factors affecting the climate of Pacific South America were based on coupled ocean/atmosphere models, physically-based statistical models and expert interpretation. The Forum endorsed the use of the NOAA National Centers for Environmental Prediction (NCEP) coupled model as the most reliable indicator for the evolution of this El Niño event in terms of SST over the next four months.

OUTLOOK

The Climate Outlook addresses the summer season (December-January-February-March 1997-1998) for Pacific South America. The experts provided probability distributions to indicate the likelihood of below-, near-, or above-normal rainfall for each subregion (see attached Map). Users are strongly advised to contact participating institutions and other climate information sources for interpretation of this Outlook and for additional guidance.

Above-normal rainfall is expected along the coast of Ecuador and northern Peru, with the detailed structure reflecting the topographic relief of the region.

Proceeding north, the regions of eastern Ecuador, Colombia, and northern Peru are expected to experience drier-than-normal conditions, especially the northwest region of Colombia.

The altiplano region of southeast Peru and western Bolivia is expected to experience drier-than-normal conditions. Most of northeastern Bolivia has slightly higher-than-average probability of a wet summer season. However, it should be noted that there was no complete consistency among the climate forecast and other indicators for this region. Some additional information suggests that the Chaco region of southern Bolivia may experience drier-than-normal conditions associated with El Niño.

South-central Chile is expected to see above normal precipitation for the remaining austral Spring season.

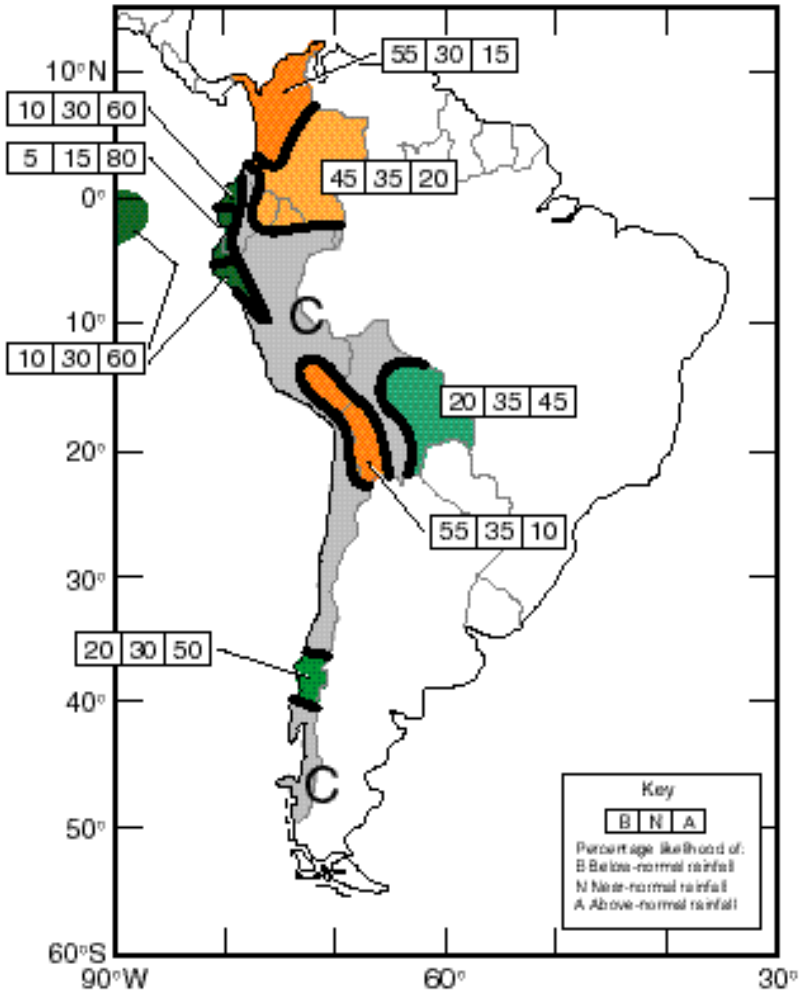
Consensus Climate Guidance

Pacific South America Climate Outlook Forum

28 October, 1997 Lima, Peru

(for list of participants and explanatory text see associated discussion)

December 1997 - March 1998



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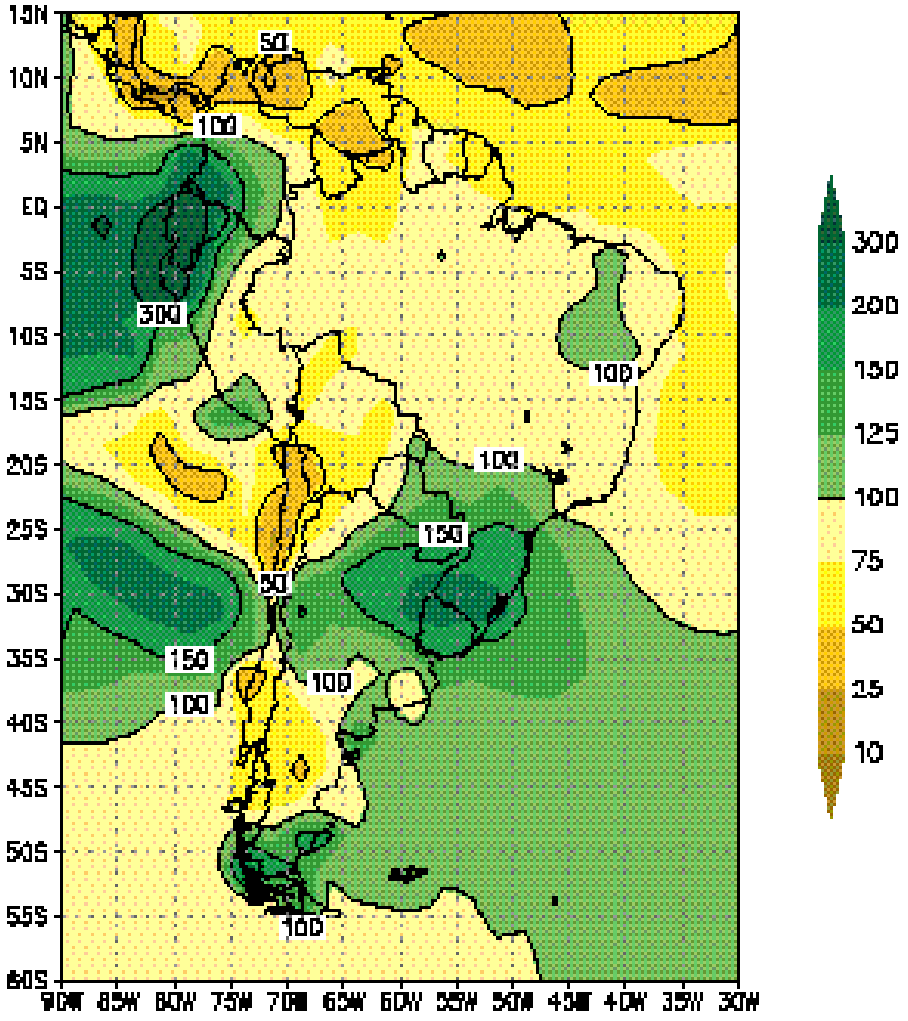

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Southeastern South America - December 1997

The Southeastern South America Regional Climate Outlook Forum, held in Montevideo, Uruguay, December 1997, and locally organized by the Uruguay Rural Association, generally followed the three-part structure described for Pacific South America. Similar to the Pacific South America event, the Montevideo meeting served multiple purposes: 1) to produce and communicate a consensus precipitation forecast for Southeastern South America for January-March 1998, 2) to discuss and plan pilot application activities for climate-sensitive sectors (e.g., agriculture-livestock, water resources, energy), and 3) to inform governments, industry, media, and the general public of the Climate Outlook and potential opportunities for using climate information. The Outlook and related discussions covered areas of Argentina, Brazil, Paraguay and Uruguay.

Workshop recommendations

Discussions of pilot applications activities were held in three separate working groups, including 1) meteorology/climatology, 2) water resources, energy, and emergency response, and 3) agriculture. Recommendations from the working groups include (with group number in parentheses):

- Establish a regular mechanism to provide seasonal forecast information to users in affected sectors (1,2,3);
- Continue discussions among the forecast users and producers to foster the creation of applicable/useful climate forecasts (1,2,3);
- Apply forecast information to sectors particularly vulnerable to climate variability, such as hydroelectric power generation, civil and emergency defense, agricultural irrigation, and water resources sectors (drinking water supply, river navigation) (2);
- Forecast river discharge using seasonal precipitation forecasts and river flow models to aid planning and response in water resource, emergency management, and energy sectors in critical river basins in the region, including the Uruguay, Paraguay, and Iguazu (2);
- Incorporate forecast information into disaster management to identify high risk areas (2);
- Create an agricultural forum to forecast seasonal precipitation amounts, demonstrate potential agricultural impacts for various precipitation scenarios, and suggest alternatives for adaptation to climate variability (3); and
- Assign representatives in each country with knowledge of the region and technical aspects of agriculture to promote results of the Forum, identify key methods in which forecast information can aid decision making, and report results of forecast incorporation into agricultural decision making to the Forum on a regular basis (3).

Outlook evaluation[24]

The Southeastern South America Climate Outlook indicated that above normal rainfall was expected in southeast Paraguay, western Uruguay, and northeastern Argentina from January to March 1998, consistent with observed wetter-than-normal precipitation amounts. The increased likelihood for below-normal precipitation in northwestern Argentina and a portion of southeast Brazil generally did not match observed conditions, although the tercile probabilities in these areas were not significantly different than climatology.[25] Similarly, above-normal rainfall was observed in eastern Uruguay and the remainder of southeast Brazil, where the forecast was essentially climatology.

[24] For a description of the qualitative method used to evaluate the Outlook, see Comparison of Climate Outlooks and Observations in the Methodology section.

[25] Aforecast for climatology indicates an equal probability of below-, near-, or above-normal rainfall (33% each). For the purposes of this evaluation, terciles with values of 45% or greater are defined as significantly different than climatology.

Climate Outlook - Rainfall

Statement from the Southeastern South America Regional Climate Outlook Forum
December 10, 1997, Montevideo, Uruguay

El Niño-Related Climate Forecast Southeastern South America Outlook
January 1998 - March 1998

SUMMARY

Wetter-than-average conditions over the period January-March 1998 are expected over much of the central parts of southeastern South America, including northeastern Argentina, southern Paraguay, and parts of southern Brazil and western Uruguay. Dry conditions are expected only in areas further north and close to the Andes. Stronger impacts in the year following El Niño events typically occur only in autumn and early winter, after the period covered in this Outlook.

THE CLIMATE OUTLOOK FORUM

On 10 December 1997, the Southeastern South America Climate Outlook Forum convened to formulate consensus guidance for the early 1998 season in the region. The Forum was attended by Meteorological Services from South-eastern South American countries, and climate scientists from universities and national and international research institutes. These specialists reviewed the state of the global climate system and its implications for Southeastern South America. One of the principal factors taken into account is the major El Niño event occurring in the tropical Pacific Ocean. Although much stronger impacts in the year following El Niño events typically occur only in autumn and early winter, after the period covered in this Outlook, recent El Niño occurrences have had significant impacts on rainfall across much of the region south of 20°S during January-March.

The Forum was co-sponsored by the Association Rural del Uruguay, IAI, NOAA, IRI and WMO. Participants at the Forum included representatives of Meteorological Services from four countries (Argentina, Brazil, Paraguay, and Uruguay) and climate scientists and other experts from national, regional, and international institutes and organizations (University of Buenos Aires, Department of Atmospheric Sciences; CIMA/CONICET/UBA; Federal University of Parana, Department of Physics; INPE/CPTEC; National University of Asuncion, Faculty of Exact and Natural Sciences; University of the Republic, Uruguay; WMO; IRI; NOAA-OGP).

METHODOLOGY

The regional climate assessment began with consensus agreement that the current El Niño will remain over the forecast period (January-March 1998). The Sea-Surface Temperature (SST) forecasts were based on coupled ocean-atmosphere models, physically-based statistical models and expert interpretation. The region considered included continental areas bounded from 20 to 40°S and east of the Andes to 47°W. This area was divided into subregions according to previous statistical analyses of the impact of El Niño events in the region. The outlook was based on dynamical forecasts presented by INPE/CPTEC and IRI models as well as results of detailed studies of El Niño impacts in this region.

The current status of seasonal-to-interannual forecasting allows prediction of spatial and temporal averages, and may not fully account for all factors that influence regional and national climate variability. This Outlook is relevant only to seasonal timescales and relatively large areas, and local variations may occur.

OUTLOOK

The experts provided probability distributions to indicate the likelihood of below-, near- or above-normal rainfall for each subregion (see Map). Above-normal rainfall is defined as within the wettest third of historically recorded precipitation totals in each region; below-normal rainfall is defined as within the driest third of precipitation totals; near-normal is the third centered around the climatological median. Users are strongly advised to contact participating institutions and other climate-information sources for interpretation of this Outlook and for additional guidance.

Above-normal rainfall is expected in southern Paraguay, the southwestern part of southern Brazil, western Uruguay and northeastern Argentina. Normal to above-normal rainfall is expected in central eastern Argentina. In Brazil, normal rainfall in the south is considered most likely; however, north of about 22°S, normal to below-normal rainfall may occur. Near the Andes, dry conditions are expected in northwestern Argentina, and there is a zone immediately to the east where average conditions are anticipated. Further south, in central western Argentina, rainfall prospects are uncertain.

Temperatures during January-March are expected to be cooler than average where above-average rainfall is indicated.

The confidence that can be placed in a three-month outlook is relatively high. Beyond three months, the reliability of statements about rainfall prospects for the region decreases because of uncertainty in the evolution of SSTs at longer time-scales. However, there are no signs that widespread dry conditions will occur in April-June, and there are indications of wet conditions in the southeastern part of southern Brazil, Uruguay, and eastern Paraguay.

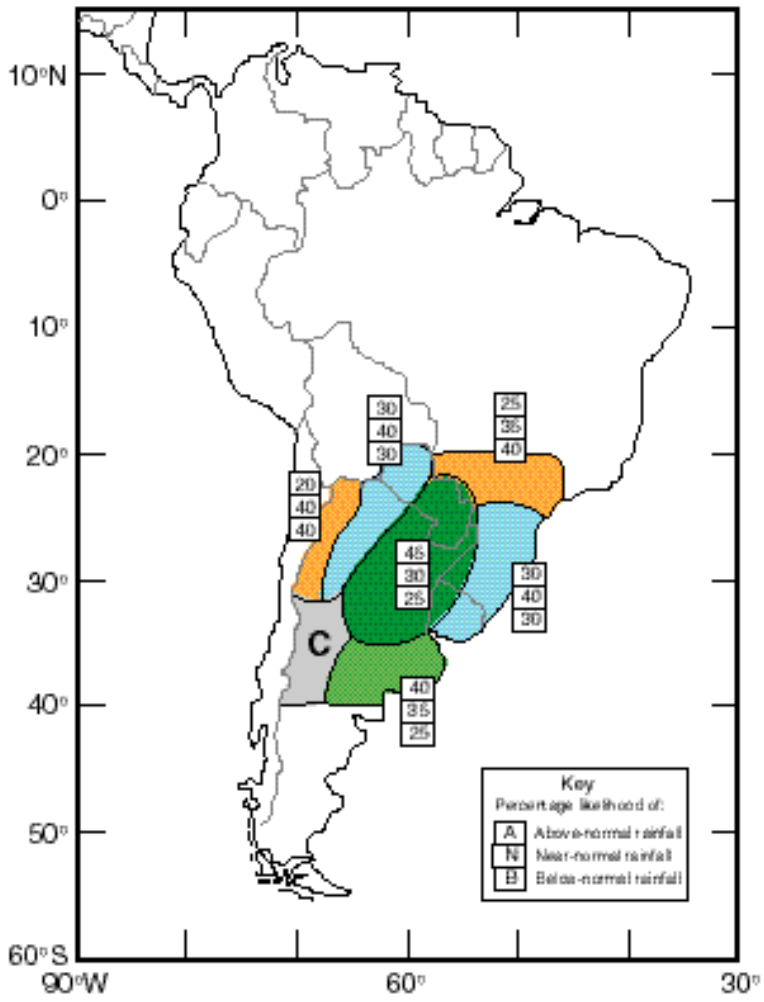
Consensus Climate Guidance

Southeastern South America Regional Climate Outlook Forum

10 December, 1997 Montevideo, Uruguay

(for list of participants and explanatory text see associated discussion)

January - March 1998



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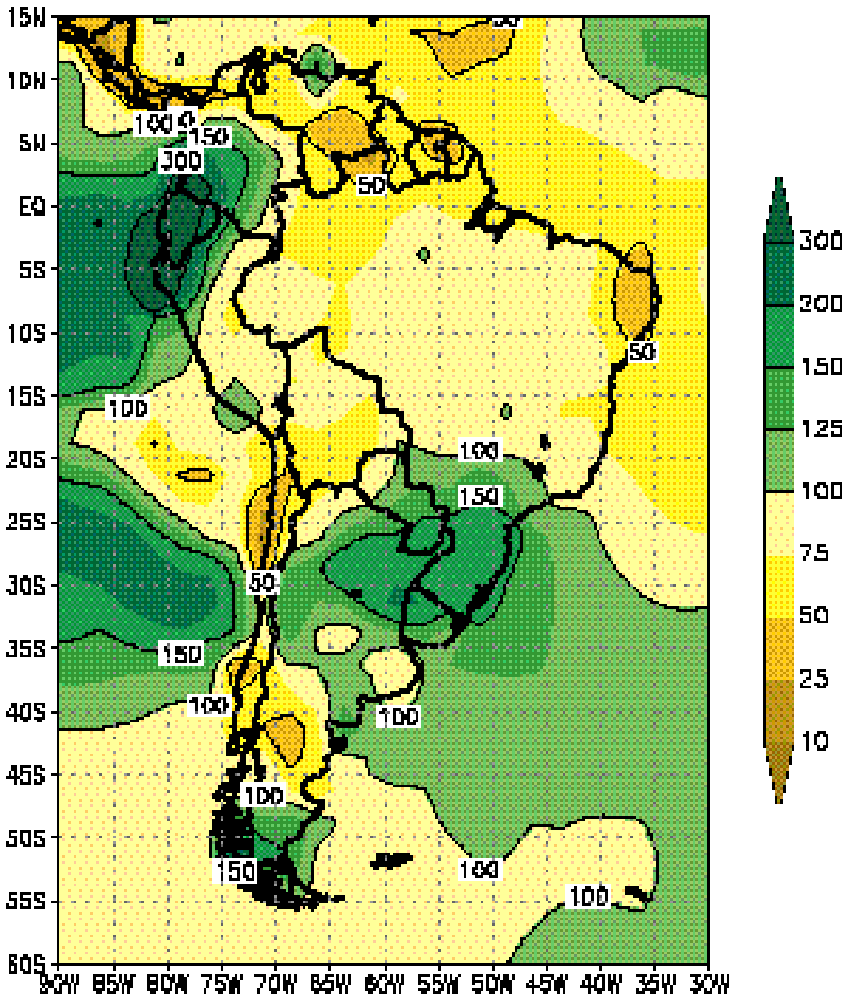

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Northeastern South America - January 1998

Using the general approach of the first two Climate Outlook Fora in South America, the Northeastern South America Climate Outlook Forum was held in Fortaleza, Brazil, January 1998.[26] Countries addressed at this event, which was hosted by Fundação Cearense de Meterologia e Recursos Hídricos (FUNCEME - Brazil) and Instituto Nacional de Pesquisas Espacias (INPE - Brazil), included Brazil, Venezuela, Columbia, and the Guyanas. Discussions of pilot applications activities were held in separate working groups focused on agriculture, water resources, civil defense and natural disaster management, and human health. Participants in the working groups included climate scientists, policy-makers, agricultural scientists, hydrologists, and natural hazard and human health specialists. Major themes emerged throughout many of the discussions:

- Effective application of climate forecasts will be aided by clarifying specific user groups, stakeholders, and institutional clients;
- Vulnerability to climate extremes varies with socioeconomic situation;
- Continued communication between forecasters and user groups will aid in building credibility of the forecasts;
- Continued research that considers the role of the Atlantic in climate in this region will help enhance the ability to forecast climate in this part of the world;
- Mechanisms for providing regional detail — for example, by down-scaling, use of agro-climatic zones, etc. — will greatly enhance the utility of forecasts; and
- An ongoing series of seasonal forecasts will allow for their improved understanding and effectiveness.

Workshop recommendations

The agriculture working group specifically recommended a pilot effort to regularly evaluate the use of climatic information during critical production cycles. The process would serve as an outreach mechanism to create linkages between forecast producers and users, to educate local groups on the use of forecast information, and to orient programs of drought mitigation. An assessment program is necessary to 1) evaluate the potential of local user groups (farmers, fishermen, government officers, state agencies, merchants, etc.) to respond to climate forecasts, and 2) to assist in preparation of comprehensive mitigation plans.

The water resources group proposed the creation of an experimental project to model hydrologic conditions in river basins of northern South America with the objective of incorporating climate-forecast information into the management of drinking water, irrigation, and hydroelectric power generation systems. It was suggested that the project should be implemented in three stages, beginning with compilation and analysis of existing information (for availability and consistency), then development and verification of a hydro-climatic model, and finally meeting with users to facilitate real time application of the model. The methodology developed and refined during the project could be applied to other river basins in northern South America and elsewhere.

Recommendations of the civil defense and natural disaster working group included the creation of two pilot application projects. The objective of the first would be to analyze the effectiveness of the Ceara waterworks program in years with and without El Niño's effect on climate. Focus sectors would include agriculture, forestry, water resources, and the environmental sector, and would range from semi-arid regions and watersheds (starting from second-order streams) to areas of greater topographic relief. The primary objective of the second pilot project

[26] The Northeastern South America Climate Outlook Forum in some cases has been referred to as the Northern South America Climate Outlook Forum.

would be to use climate forecasts in the development of an early-warning system for forest fires. Increased lead-time on the potential for forest fires would benefit biodiversity conservation efforts, civil defense, forestry, and agriculture sectors.

The human health working group recommended that available historical records on the incidence of specific health conditions be analyzed to determine potential correlations to climate patterns associated with ENSO. Once correlations are established, more detailed studies should be completed to control for confounding factors that may influence the occurrence of a given disease. The working group recommended that climate forecasts would be useful in mitigating climate-associated diseases by reducing vulnerability of at-risk populations, through construction of water reservoirs, food aid, etc., and by taking specific preventative actions such as vaccination, vector control, targeted epidemiological surveillance, and health education.

Outlook evaluation[27]

The Northeast South America Outlook indicated there would likely be drier-than-normal conditions in northern Brazil from February to May 1998, particularly in the northeast. Observed precipitation amounts in this area were consistent with the Climate Outlook, although rainfall in northwestern Brazil was generally greater than 75% of average. The area of increased likelihood of near-normal rainfall in extreme eastern Brazil was not reflected in the below-normal precipitation observed for this region (although below-normal was forecast at 30% probability). The band of expected drier-than-normal rainfall running through eastern Peru, southeastern Columbia, and most of Venezuela was inconsistent with observations which indicated rainfall amounts near-to-above normal. Similarly, most of northern Columbia had near-to above-normal rainfall, even though below-normal amounts were projected (a 75% likelihood). Although rainfall amounts 300% of average observed in northern Ecuador appear to be in agreement with the Outlook, the observational data lacks the detail necessary to resolve the forecast in this region.[28]

[27] For a description of the qualitative method used to evaluate the Outlook, see Comparison of Climate Outlooks and Observations in the Methodology section.

[28] The estimated percent normal precipitation maps used for the Outlook evaluation have a spatial resolution of approximately 2.5° longitude by 2.5° latitude. Since the forecast area in northern Ecuador is smaller than 2.5° by 2.5°, a higher-resolution map of rainfall observations is necessary to evaluate the Outlook.

Climate Outlook - Rainfall

Statement from the Northeastern South America Regional Climate Outlook Forum
January 20, 1998, Fortaleza, Brazil

THE CLIMATE OUTLOOK FORUM

A Climate Outlook Forum was convened on January 20, 1998 to formulate a consensus precipitation forecast in northern and northeastern South America for the period February - May 1998. The Forum was comprised of climate researchers and representatives of meteorological services from Brazil, Colombia, French Guyana, Suriname, Venezuela, and the U.S.A. Participating institutions included INPE, FUNCEME, the Instituto Nacional de Meteorologia (INMET), the Universidad Simon Bolivar (USB), the Universidad Nacional de Colombia, NOAA-OGP, IRI, WMO, and IAI. The participants reviewed the state of the global climate system and its implication for northern and northeastern South America.

METHODOLOGY

Sea-Surface Temperature (SST) anomalies in the tropical Pacific and Atlantic oceans are among the most important predictors of rainfall anomalies in northern South America. The present SST anomalies in the central and eastern Pacific are among the largest ever recorded, with positive anomalies in some locations exceeding 5° C. Predictions call for warm conditions to continue for at least 3 months. Anomalously warm SSTs, referred to as El Niño, have been historically associated with dry conditions over most (but not all) of northern and northeastern South America. By contrast, prediction of rainfall anomalies based on present SST anomalies in the Atlantic is more ambiguous, with a weak dipole pattern favorable for enhanced rainfall in parts of northern South America (i.e., opposing the effect of El Niño).

This regional climate outlook began with consensus that the current El Niño event is the strongest recorded in this century. The Sea-Surface Temperature (SST) forecast and other factors affecting the climate of northern and northeastern South America were based on atmospheric general circulation models, coupled ocean/atmosphere models, physically-based statistical models, and expert interpretation. The Forum endorsed the use of the NOAA National Centers for Environmental Prediction (NCEP) coupled model as the most reliable indicator of the evolution of this El Niño event in terms of Sea-Surface Temperature for the next three months.

In the discussions, experimental seasonal forecasts from the CPTEC/COLA, IRI/MPI, NCEP, ECMWF, ARPEGE-CLIMAT climate models, and statistical models for northeastern Brazil and Venezuela have been considered. The forecast area in the present exercise is limited from 15°S to the northern coast of South America, excluding Peru, Ecuador, and Bolivia. It is necessary to remember that the end of the period February-May is arbitrary, and cuts through different climatic seasons in different subregions.

OUTLOOK

The Climate Outlook addresses the February-April 1998 period for northern and northeastern South America. The experts provided probability distributions to indicate the likelihood of below-, near-, or above-normal rainfall for each subregion (see attached map). Users are strongly advised to contact participating institutions and other climate information sources for interpretation of this Outlook and for additional guidance. It is emphasized that the locations of the boundaries between the subregions are only qualitatively correct, and should be considered as transition zones rather than sharp boundaries.

All regions have enhanced probability of drier than normal except the southern parts of Northeast Brazil (Bahia) and the southwestern coastal region of Colombia. In particular, the northern parts of Northeast Brazil (eastern Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba and Pernambuco and parts of northern Bahia) have particularly high probabilities of a drier than normal period.

The ocean-atmosphere system is changing at this time, and should the situation in the tropical oceans be altered significantly in the three-to-four weeks to follow, the climate outlook for the upcoming rainy season in northern Northeast Brazil (March-May) may require modification. In particular, the meteorological community should keep watch on the developments in the Atlantic.

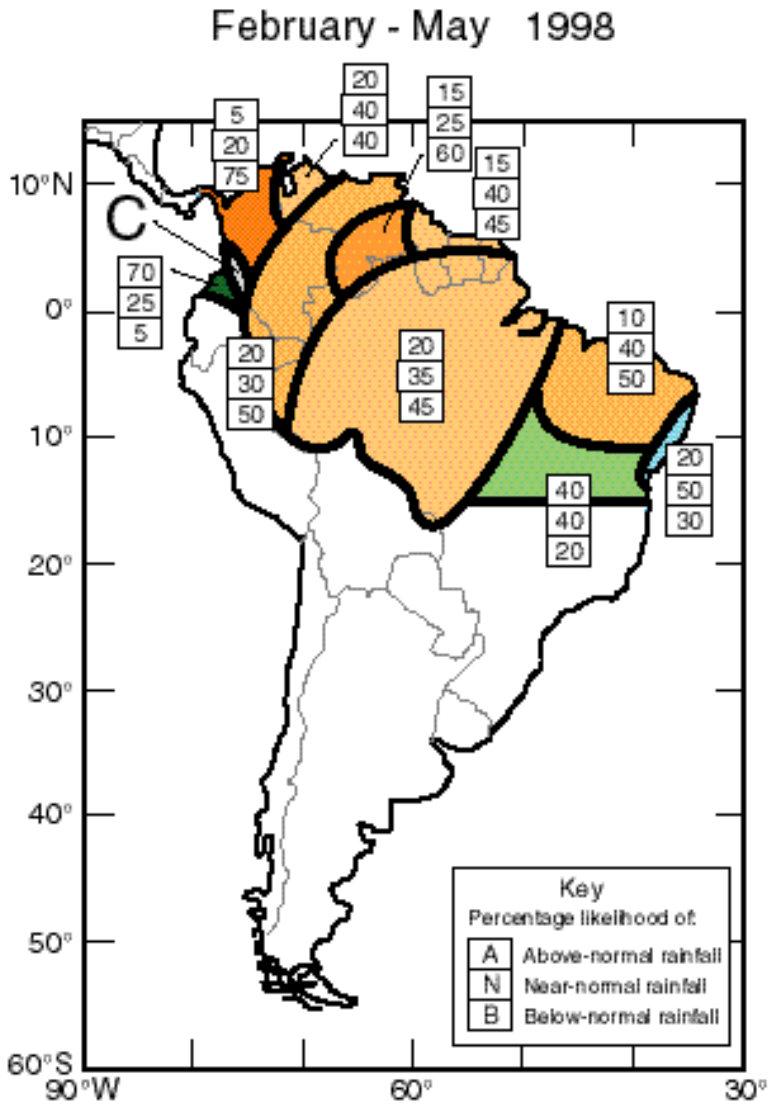
Recent studies have indicated an inverse relation in which dryness in northern coastal regions of Northeast Brazil is accompanied by enhanced rainfall along the coast of Guyanas. The present outlook does not reflect this, as February-April is a dry season in the Guyanas and northern Venezuela.

Consensus Climate Guidance

Northeastern South America Regional Climate Outlook Forum

20 January, 1998 Fortaleza, Brazil

(for list of participants and explanatory text see associated discussion)



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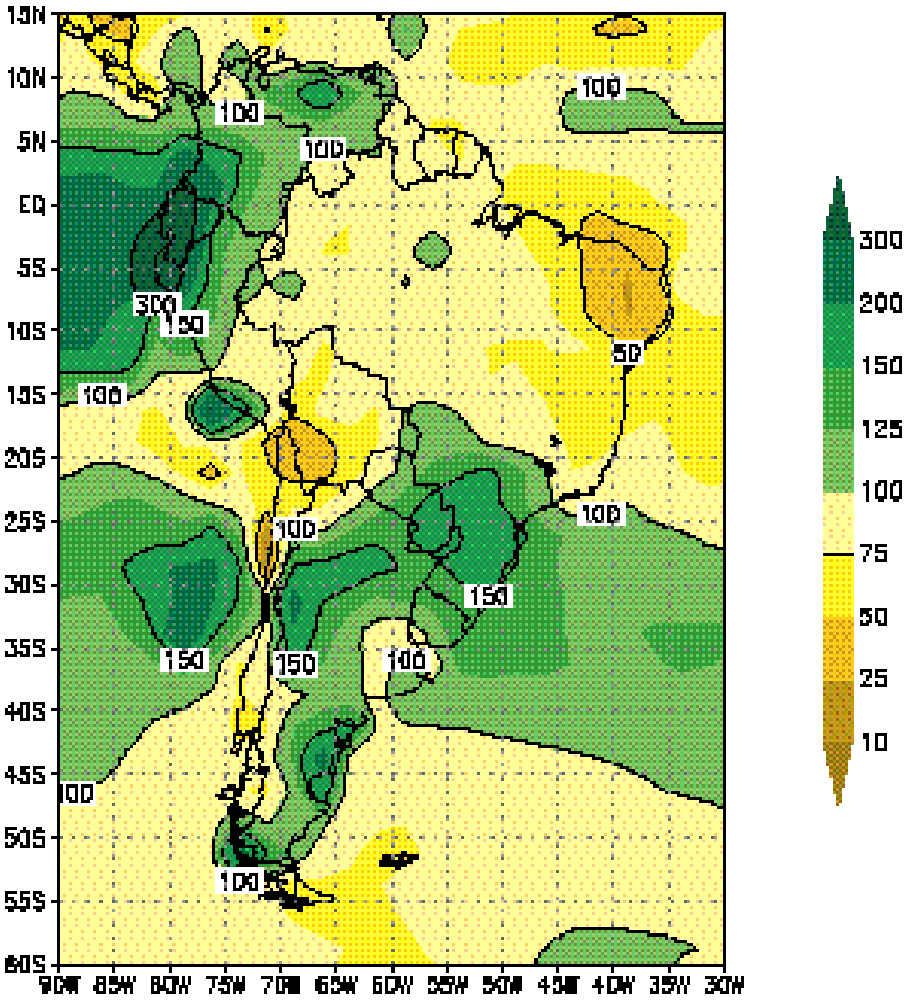

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Mesoamerica - May 1998

The Mesoamerica Climate Outlook Forum, which took place in Panama City, Panama, May 1998, was organized by the Water Center for the Humid Tropics of Latin America and the Caribbean (CATHALAC). The Forum consisted of two main activities, including the creation of a consensus precipitation forecast for Mesoamerica (all of Central America, Columbia, and Venezuela) for June-August 1998, and a press conference to release the forecast results to members of both the televised and published media. Similar to the preceding Fora, the meeting involved both climate modelers and representatives of National Meteorological and Hydrological Services from throughout the region. The press briefing included members of local and regional news media organizations. Abrief meeting between Outlook Forum participants and the Panamanian ENSO Commission also occurred, to inform the Commission of Forum results and the general assumptions on which the forecast was based, and to address questions related to application of climate forecast information.

Outlook evaluation[29]

The Climate Outlooks for Mesoamerica and the Caribbean were created with the assumption that unusually warm sea-surface temperatures (SSTs) in the equatorial Pacific associated with El Niño would decay slowly over the forecast period (see Outlook descriptions). In reality, however, temperatures decayed very quickly, with large portions of the central equatorial Pacific showing negative SST anomalies by early June.[30] Given this discrepancy, the following forecast evaluation, as well as that for the Caribbean, should be viewed as an example of how climate forecasts fare when the SSTs on which they are based change more rapidly than anticipated.

The Outlook for Mesoamerica indicated an increased likelihood of drier-than-normal conditions in central and northern Mexico from June to August 1998. While much of this region experienced below-normal rainfall during this time, there were also areas with near- to above-normal rainfall. Southern Mexico, on the other hand, was forecast to have wetter-than-normal conditions, while the rainfall it received was in the near-normal range. The narrow strip of below normal precipitation forecast for eastern Guatemala, western Honduras, western Nicaragua, western Costa Rica, and Panama was generally consistent with observed near- to below-normal rainfall in these areas. Three areas forecast for wetter-than-normal conditions, one in western Guatemala, one in southeastern Nicaragua, and one in northern Ecuador, are too small to be resolved with available observational data.[31] Rainfall at near- to below-normal levels in the Yucatan peninsula, Baja California, Belize, eastern Honduras, and eastern Nicaragua were generally inconsistent with the forecast for climatology in these areas. Most of Venezuela and Columbia experienced precipitation in the near-normal range from July to August, matching the forecast for this region.

[29] For a description of the qualitative method used to evaluate the Outlook, see Comparison of Climate Outlooks and Observations in the Methodology section.

[30] The region between 5°N and 5°S latitude and 170°Wand 120°Wlongitude in the equatorial Pacific (the Niño 3.4 region) showed negative anomaly values by early June and decreased through late August 1998. Niño 3.4 is expressed relative to a long-term SSTaverage, and therefore can be either positive or negative. During November 1997, in the midst of the El Niño event, the Niño 3.4 value reached almost 3.0°C, whereas by the end of June 1998, it had fallen to nearly -1.0°C.

[31] The estimated percent normal precipitation maps have a spatial resolution of approximately 2.5° longitude by 2.5° latitude. The forecast areas in western Guatemala, southeastern Nicaragua, and northern Ecuador are smaller than 2.5° by 2.5°, indicating higher-resolution observational data is necessary for Outlook evaluation.

Climate Outlook - Rainfall

Statement from the Mesoamerica Climate Outlook Forum 18-19 May 1998, Panama City, Panama

THE CLIMATE OUTLOOK FORUM

A Climate Outlook Forum was convened on May 18-19, 1998 to analyze the current state of the global and regional climate and formulate a consensus precipitation forecast for Mesoamerica for the period of June-July-August 1998. The Forum consisted of researchers and representatives of meteorological services from Mexico, Belize, El Salvador, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Columbia, and Venezuela. The event was organized and sponsored by the following organizations: INRENARE, CATHALAC, NOAA-OGP, IRI, IAI, USAID-OFDA, and WMO.

METHODOLOGY

Sea-surface temperatures (SSTs) in the tropical Pacific Ocean are a significant factor influencing regional atmospheric dynamics and rainfall in the Mesoamerican region. Historical climate records, present climatic conditions, and SST predictions for the central and eastern equatorial Pacific from NCEP were used to produce a climate outlook for Mesoamerica. It was agreed that anomalously warm SSTs associated with 1997-98 El Niño are starting to weaken and would continue to do so through the forecast period.

The outlook applies to precipitation for the period June-August 1998, as a longer time frame would increase uncertainty in the outlook. The activity of the Inter-Tropical Convergence Zone, the westerly waves, and hurricanes in the Pacific and the Caribbean will likely influence the amount of rainfall in the Mesoamerican region.

Projected precipitation anomalies are shown using a probabilistic approach. The predictions consider the likelihood that the total amount of rainfall will be near normal, above normal or below normal (Fig. 1). The map indicates the probability that precipitation during the period June-July-August will be among the wettest (upper block), the normal (middle block) or the driest (lower block) years in the historical record.

OUTLOOK

The Inter-Tropical Convergence Zone (ITCZ) is the band of clouds and intense tropical rains that is located north of the geographic equator during the period of June-August. During El Niño years, the ITCZ tends to migrate more slowly to northern latitudes. Therefore, a delay for the onset of the rainy season is expected. At the same time, anomalously strong easterly winds over Central America generally cause strong orographic rainfall in the Caribbean coastal region of Central America, while rainfall is generally reduced in the Pacific coastal regions.

The precipitation Outlook for the period June-July-August of 1998 for the Mesoamerican region is given in the accompanying map. The boundaries between the subregions should be considered as transition zones rather than sharp boundaries.

Over Mexico, a delay of the onset of the rainy season is predicted. Hence, most of the country will have a deficit in accumulated rainfall for the forecast period. Only in the Gulf of Mexico region will rainfall likely be above normal. It is expected that precipitation in the peninsula of Baja California and in Yucatan will be close to normal.

In most of the countries of Central America the rainy season will begin later than May, the usual onset of the rainy season. It is probable that the rainfall anomalies will continue to occur over a major part of the Isthmus during the forecast period. It is expected that below normal precipitation will occur on the Pacific coast of Central America, from the south of Guatemala to Panama. Rainfall deficits are also expected in the north of Guatemala and central Honduras. Zones that will likely register rainfall quantities above normal include the western coast of Guatemala, the northeastern part of Costa Rica, and the southeastern part of Nicaragua. The remaining Caribbean coastal region will likely have precipitation close to normal.

In the southeastern part of Mesoamerica, Colombia, and Venezuela, it is probable that conditions will be close to normal with slight deficits in precipitation.

Although the 1997-98 El Niño is weakening, it will continue to affect the region during the outlook period. The disappearance of El Niño's climatological effects will depend on the rate at which SSTs in the equatorial Pacific decrease.

WARNING

The forecast is a general vision of the most probable behavior of the regional climate. Due to the large-scale nature of the forecast, there are likely to be local rainfall patterns that vary significantly from the outlook. Decision making at the national or local level should take this into account. Users of climate data are invited to contact their national organizations that are tasked with making national climate predictions to receive more specific guidance on how to interpret the available information.

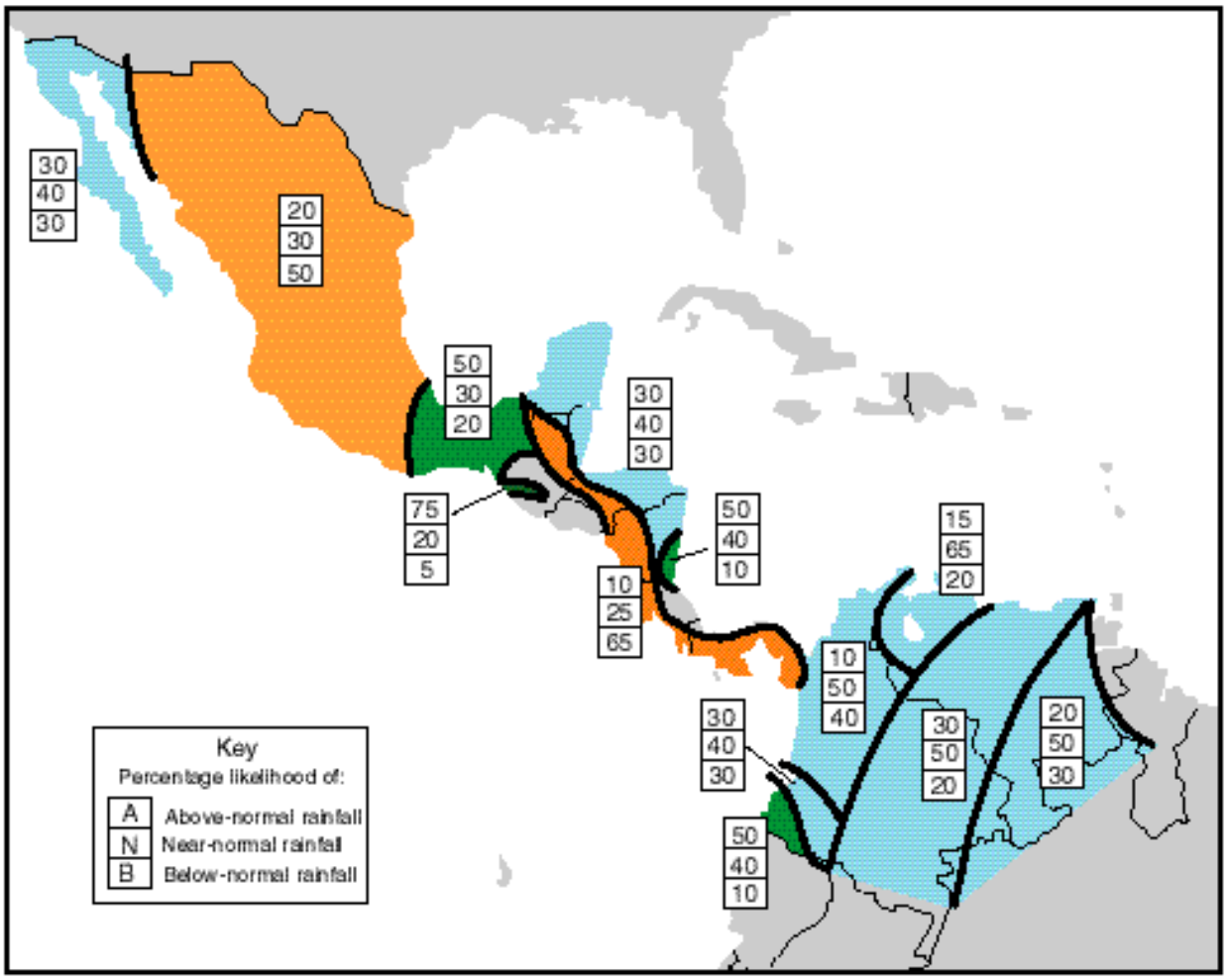
Consensus Climate Guidance

Mesoamerica Climate Outlook Forum

18-19 May, 1998 Panama City, Panama

(for list of participants and explanatory text see associated discussion)

June - August 1998



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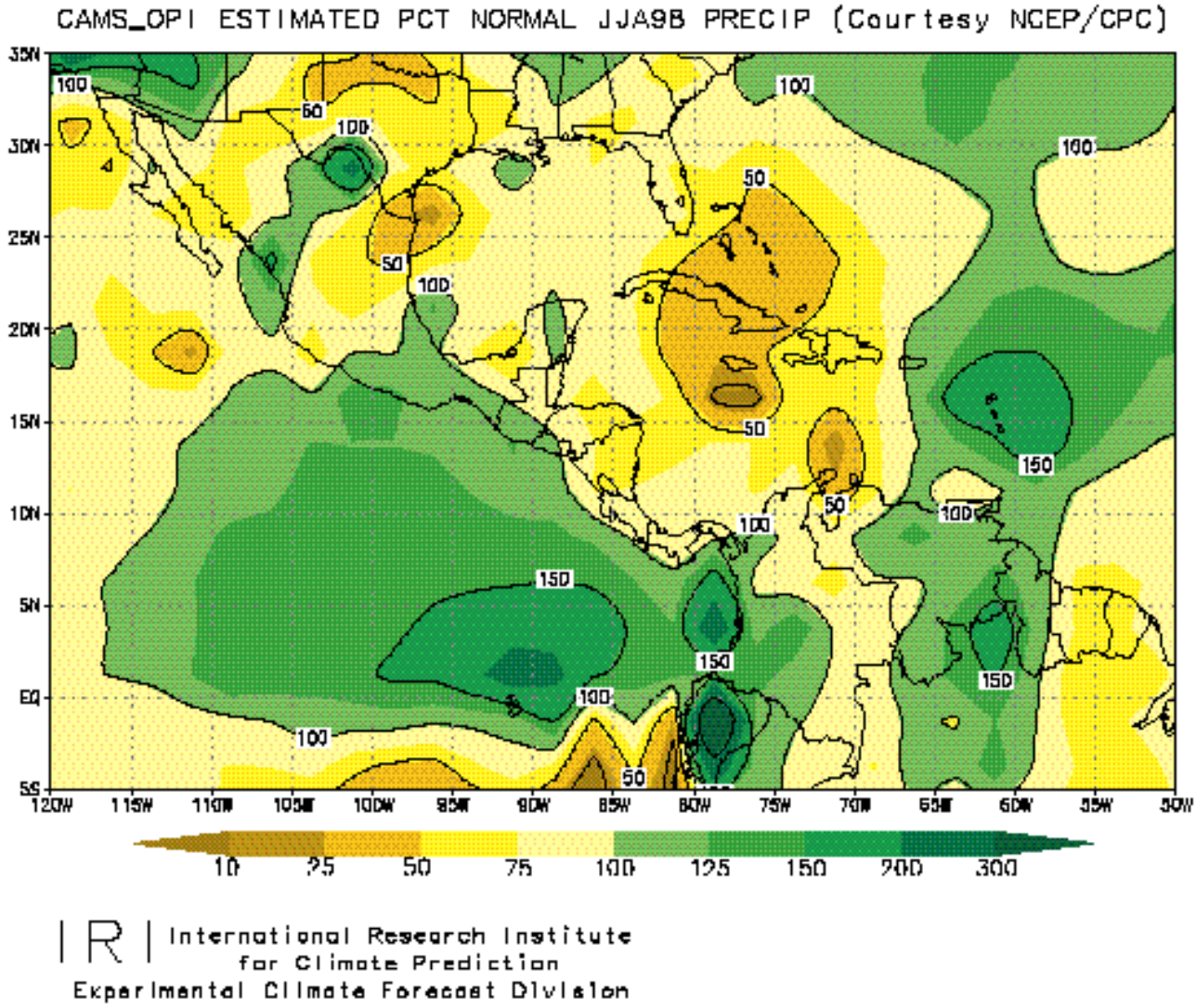
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Caribbean - May 1998

The Caribbean Climate Outlook Forum was held in Kingston, Jamaica, May 1998, and was locally organized by the University of the West Indies and the Office of Disaster Preparedness and Emergency Management. While the main purpose of the Forum was to create a consensus precipitation forecast for June to August 1998 for the Caribbean region, it also included a natural disaster preparedness discussion to allow forecast producers and users (in this case natural disaster managers) to exchange views on the application of forecast information.

Working group recommendations

The natural disaster preparedness discussion consisted of two working groups. One focused on scientific issues related to forecast creation, the other on the needs of natural disaster preparedness managers vis-a-vis climate forecasts. Some agreement emerged from the working groups, including:

- Forecasts issued by the IRI, the Center for Ocean-Land-Atmosphere (COLA), or NOAA-CPC should be modified by local meteorological offices to suit user needs;
- The 3-month Outlook produced at the May 1998 meeting will be updated on a monthly basis by participants throughout the region — the Caribbean Meteorological Institute (CMI) volunteered to coordinate these forecast updates;
- Enhanced utility of the Outlook will occur if resolution increases to subregional level, if forecast type is linked to particular situations, and if the forecast is updated on at least a quarterly basis; and
- Establishment of a group of critical stakeholders in the region — including those involved in monitoring, resource use, and policy making — will ensure that a structured environment and direction exists for creating and sustaining a regional capability for applying climate forecast information.

Outlook evaluation[32]

The Climate Outlook for the Caribbean region, which covered June to August 1998, indicated an increased likelihood of drier-than-normal conditions for the Northern Leeward Islands and the Netherlands Antilles. While observations for the Netherlands Antilles matched the forecast, those for the Northern Leeward Islands did not. Puerto Rico, the Virgin Islands, and the southern Windward Islands experienced near-normal rainfall, consistent with the Outlook for increased probability of near-normal conditions. The Southern Leeward Islands and northern Windward Islands were wetter than normal during June to August, despite a forecast for increased likelihood of near-normal rainfall. The Outlook for the Bahamas and Jamaica was for near- to below-normal rainfall, generally matching observations. Cuba, Haiti, and the Dominican Republic all experienced rainfall in the below-normal range from June to August, despite the Outlook for near- to above-normal conditions.

[32] For a description of the qualitative method used to evaluate the Outlook, see Comparison of Climate Outlooks and Observations in the Methodology section. See also the Outlook evaluation for Mesoamerica for further information regarding the Caribbean Outlook.

Latin America and Caribbean Survey Results

To evaluate the Outlook Fora and determine how the forecast information produced at them was used, NOAA-OGP sponsored a survey of participants in the Latin America and Caribbean Outlook Fora, Applications Workshops and Conferences. Survey results were compiled at the International Institute for Applied Global Change Research (GAIA), Ensenada, Mexico. Of 286 participants, 119 responded to the survey. Of the 119 respondents, approximately 50% were from academic research centers and National Meteorological and Hydrological Services, and about 30% were from agricultural, fisheries, water resources, disaster mitigation, and health sectors. The remainder were from various public agencies.

About 60 respondents were directly involved in creating the consensus Outlooks, and 25% of this group indicated they had previous experience in generating climate forecasts. This statistic highlights the need for training in the methods of climate forecasting in the Latin America and Caribbean region. Despite this relatively small number of experienced forecasters, the majority of respondents to the survey (60%) indicated the Outlooks were generally representative of precipitation amounts during the forecast period (15% indicated the Outlooks were not representative of rainfall conditions and 25% had no opinion). Respondents indicated that the climate forecast information from the Outlook Fora was used to:

- Develop risk maps for river basin flooding;
- Inform the agricultural sector in various countries of the potential for droughts and floods;
- Advise the agricultural sectors in certain regions to alter timing and type of crops to be planted;
- Inform government representatives and ministries of agriculture, water resources, and health of drought and flood potential;
- Define rainfall probabilities for river flow models, which in turn served as a basis for flooding alerts;
- Create a system to regulate water reserves for energy production; and
- Support requests for emergency funding in certain regions.

The vast majority of respondents indicated that consensus forecasting activities similar to the Outlook Fora should continue, indicating the success of these events in facilitating forecast applications, and the potential for future forecasting networks to develop in Latin America and the Caribbean. To fully achieve the original objectives of the Fora (identifying gaps in information and technical ability, improving information exchange and coordination within the forecasting community, and discussing issues related to Outlook development and use), it was suggested that more time be allotted to each Outlook Forum for participants to address these issues. Intra-country meetings following the regional Outlook Forum that include potential forecast users at the local level would further encourage the use of forecast information. Although over 70% of survey respondents indicated the format of the Outlooks was usable, several offered suggestions for improvement:

- Include a more thorough explanation of probabilities and the limitations of available forecast products;
- Include information on rainfall distribution within the season and probability of extreme events;
- Provide numerical rainfall values to accompany the terciles;
- Enhance Outlook spatial resolution and present probabilities in greater detail than terciles (i.e., dividing the forecast into four or more categories);
- Offer additional forecast products, such as thermocline depth, transpiration rates, humidity levels, soil moisture, and minimum-maximum temperatures on land; and
- Standardize the methods for producing and evaluating individual forecast contributions to the consensus product, and an approach for evaluating the consensus forecast itself.

Climate Outlook - Rainfall

Statement from the Caribbean Regional Climate Outlook Forum
21-22 May 1998, Kingston, Jamaica

THE CLIMATE OUTLOOK FORUM

A Climate Outlook Forum was convened on May 21-22, 1998 to formulate and communicate a consensus precipitation forecast for the Caribbean for the period of June-July-August 1998. In addition, the Forum intended to identify gaps in information and technical capability; facilitate research cooperation and data exchange within and between regions, and improve coordination within the climate forecasting community.

The Forum was comprised of climate researchers and representatives of meteorological and hydrological services and disaster preparedness officials from the Bahamas, the British Virgin Islands, Barbados, Puerto Rico, Antigua, Dominican Republic, Haiti, Cuba, Saint Lucia, Trinidad and Tobago, Netherlands Antilles, and Jamaica. Additional participating institutions included Florida State University, the University of Maryland, the Hurricane Research Division of NOAA, COLA, NOAA-CDC, IRI, NOAA-CPC, Service National des Resources Naturaelles et Resources en Eau, the Caribbean Meteorological Institute, the University of the West Indies, the Office of Disaster Preparedness and Emergency Management (ODPEM), USAID-OFDA, NOAA-OGP, IAI, WMO, and the Caribbean Disaster Emergency Response Agency.

The Climate Outlook Forum was co-sponsored by the University of the West Indies, ODPEM, IAI, NOAA-OGP, WMO, and USAID-OFDA.

METHODOLOGY

Sea-Surface Temperature (SST) anomalies in the Pacific and Atlantic Oceans and Caribbean Sea are among the most important predictors of rainfall anomalies in the Caribbean region. The present SST anomalies in the central and eastern Pacific are among the largest ever recorded, with positive anomalies exceeding 4° C. Current predictions call for diminishing SST anomalies over the next few months in the equatorial Pacific; however, it is felt that this El Niño episode will continue to affect the Caribbean region during the period of June-August 1998. Therefore, this Climate Outlook takes into consideration the lingering effects of the current El Niño event and the local topography of this region. The Climate Outlook was generated through analysis of historical climate records throughout the region, data available from the global climate-monitoring system, and computer models of the evolution of the global SST field.

The Caribbean region has diverse topography and high regional variability in precipitation regimes. The wet seasons in the region are primarily of a bi-modal distribution with an early- and late-season peak, the exception being the Northern Leeward islands. This is reflected in the range of probabilities that were arrived at in the consensus. The forecast area was divided into 8 regions, with Cuba further subdivided into 2 regions. Due to this large scale nature of the forecast, there are likely to be local rainfall patterns that vary significantly from the outlook, particularly in mountainous regions.

Seasonal climate forecasting is still a relatively new science, and future forecasts can be improved through increased local and regional exchange of data and knowledge. This is of particular importance in the Caribbean region, where there is high spatial and temporal variability. Because of the relatively small spatial scale of most of the islands in the region, there is a need to explore the use of mesoscale models in climate prediction.

OUTLOOK

The Climate Outlook addresses the June to August 1998 period for the Caribbean region. The experts provided probability distributions to indicate the likelihood of below-, near-, or above normal rainfall for each subregion (see attached map). For this purpose, “normal” is defined as the climatological mean. Users of this Outlook are strongly advised to contact participating institutions and other climate information sources for interpretation of this Outlook and for additional guidance. It is emphasized that the locations of the boundaries between the subregions are only qualitatively defined, and should be considered as transition zones rather than sharp boundaries.

Wetter-than-normal conditions are expected in the Western two-thirds of Cuba, while near-normal conditions are expected in the eastern part of the island. Near-normal conditions are also expected for Haiti and the Dominican Republic. For the Bahamas and Jamaica, a moderate tendency toward drier conditions is anticipated, while conditions in Puerto Rico and the Virgin Islands are expected to be normal to slightly above normal. The northernmost Leeward Islands are expected to be affected by the lingering effects of El Niño with lower-than-normal rainfall projected. This is thought to be in part due to the persistent strength of the North Atlantic high-pressure ridge. The southern Leeward Islands and the Windward Islands may experience rather normal conditions due to the possibility of more normal activity in the Inter-

Tropical Convergence Zone (ITCZ). Rainfall from ITCZ disturbances have already started to affect Trinidad and Tobago by mid-May. Rainfall in the dry zone off the coast of South America has been well below normal since March 1997. Tercile analysis for the island of Curacao shows that the driest third of historical years include all strong El Niño events in the last 60 years. Consequently, continuing drier conditions are anticipated for the Outlook period.

The best educated consensus is that the effects of the current El Niño event on the Atlantic basin tropical cyclone activity will persist at least through the month of August. We expect the strong vertical shear over the Atlantic tropics associated with El Niño will inhibit tropical cyclone development. This effect is most pronounced over the Caribbean region and therefore, we would expect minimal hurricane activity in the region at least through the month of August. Although an occasional system might develop and even reach tropical storm strength, there is a low probability of any system reaching hurricane strength. However, it must be recognized that even inactive years can produce disasters. Firstly, enhanced precipitation from a weaker system can still cause flooding. Also, there can still be an occasional exception (i.e., a hurricane affecting the Caribbean region even during an overall inactive period). Although the exceptions are rare, normal hurricane preparedness efforts should still be maintained.

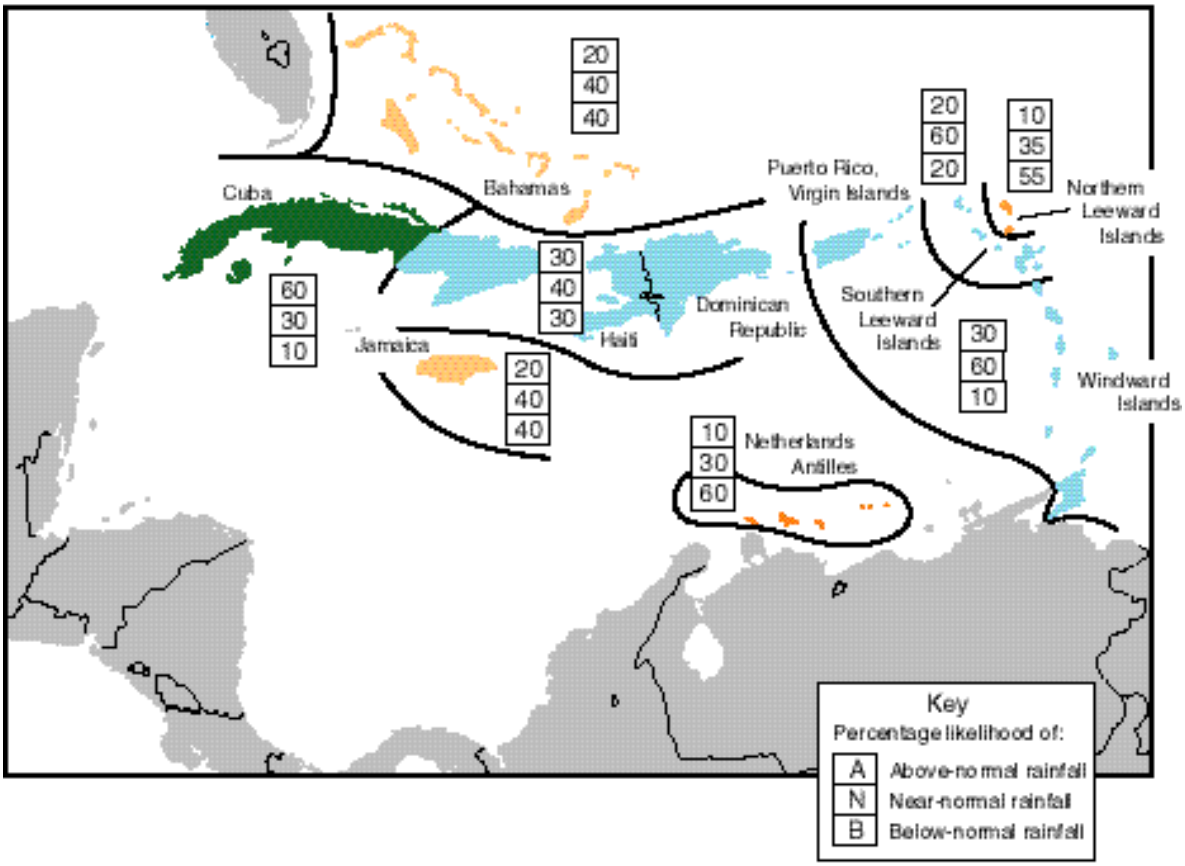
Consensus Climate Guidance

Caribbean Regional Climate Outlook Forum

21-22 May, 1998 Kingston, Jamaica

(for list of participants and explanatory text see associated discussion)

June - August 1998



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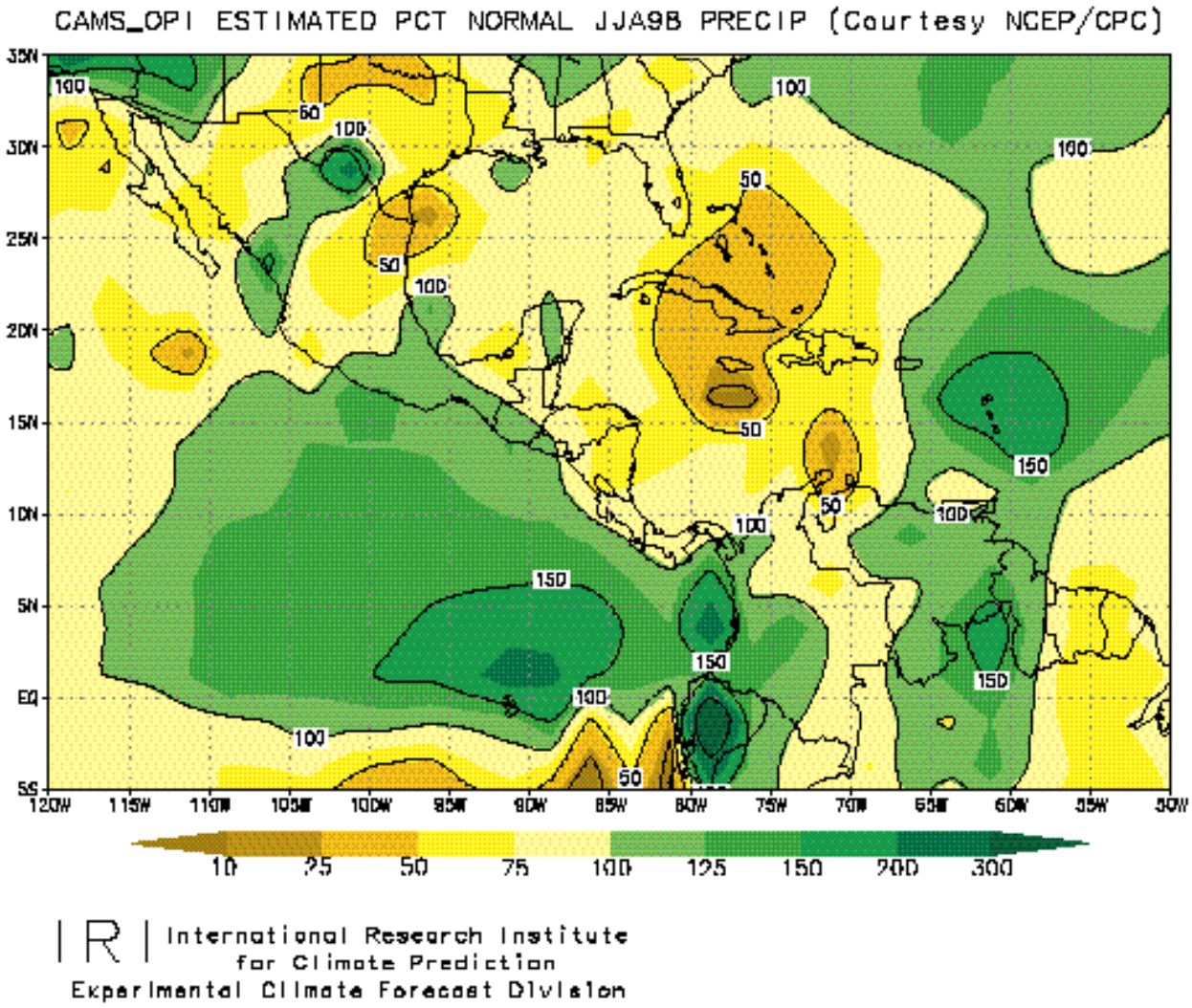
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Southeast Asia Outlook Forum - February 1998

As the 1997-98 El Niño developed, the Asian Disaster Preparedness Center (ADPC) and NOAA-OGP took the initiative to host an "Asian Regional Meeting on El Niño Related Crises." The event, sponsored by USAID-OFDA, was held in Bangkok, Thailand, February 1998. The primary foci of the meeting were 1) to discuss enhancement of capability in short-term forecasting of El Niño-generated weather patterns, 2) discuss application of forecasts both regionally and internationally, and 3) to generate a consensus precipitation forecast for the Southeast Asia region for February to April 1998. Other topical issues included the role of forecasts in early warning and impacts assessment, and the need for public education, information dissemination, and contingency planning. The Outlook Map, description, and a map of observed precipitation amounts for the forecast period, expressed in terms of percentage of normal rainfall, follow in the next few pages.

The Southeast Asia meeting attracted 130 delegates from 21 countries including those of the Asia and Pacific regions, and received worldwide media coverage. It brought together national policy and decision makers (from various sectors including: public health and population welfare; industry and economy; natural resources and environment; and industry and economy), regional and international climate scientist and organizations, disaster managers from countries in the region, representatives from the international humanitarian assistance community, bilateral and multilateral donors, the Asian Development Bank, non-governmental organizations, and regional media representatives. The meeting also provided a crucial interface between meteorologists and national agencies charged with responding to crises that significant disruptions, such as El Niño, cause in expected climatic cycles.

This event facilitated an exchange of information and experiences between professionals and helped elucidate the potential and limitations of forecasting such events. It indicated that the correlation between ENSO events and changes in the normal climate cycle varies significantly among countries in the region. It further highlighted the need for additional study on the impact that temperature fluctuations in the Indian Ocean may have on the weather patterns and rainfall for south and southeast Asia.

Participants at the Southeast Asia Outlook Forum focused on the importance of long-lead forecasts in alleviating social and economic costs related to climate variations, and the need for political and financial support to establish an integrated regional climate information system. It was emphasized that these climatic events tend to magnify human mistakes and absence of planning. A number of follow-up actions are being envisaged including: 1) facilitation of a Regional Climate Forum and establishment of a Regional Strategic Planning Committee; 2) establishment of a Pilot Regional Information Clearing House at ADPC as an operational instrument of the above two Fora; and 3) development of a long-term, multi-institutional program on "Regional Capacity Building for Climate Forecasting and Applications."

Outlook Evaluation[33]

Many Southeast Asian nations experienced drier-than-normal conditions from February to April 1998. For most of the Philippines, rainfall amounts were less than half of normal levels, consistent with the Climate Outlook of 70% likelihood for below-normal precipitation. Sri Lanka and islands in south-central Indonesia were forecast at 50% probability for below-normal precipitation, also in general agreement with observations. Indonesia and New Guinea were forecast to have near-to below-normal rainfall, which they did, except for western New Guinea. Much of Vietnam, Thailand, and Cambodia experienced drier-than-normal conditions, matching the forecast for increased likelihood of below-normal rainfall in these areas.

[33] For a description of the qualitative method used to evaluate the Outlook, see Comparison of Climate Outlooks and Observations in the Methodology section.

Climate Outlook - Rainfall

Statement from the Southeastern Asia Regional Climate Outlook Forum
2 February 1998, Bangkok, Thailand

SUMMARY

Below-normal rainfall conditions will continue to prevail in most parts of the region during the period February through April 1998. Indications for below average rainfall are strongest in the Philippines, northeastern Kalimantan, the northern Sulawesi, and the region around the Bay of Bengal, including Sri Lanka and around the South China Sea. Above-average precipitation is expected only in western Sumatra and southeastern China. These conditions are consistent with precipitation patterns usually associated with the mature phase of a major El Niño, such as occurred in previous events (e.g.,1982-83) and the current event (e.g.,1997-98).

THE CLIMATE OUTLOOK FORUM

A Regional Climate Outlook Forum convened in Bangkok on Feb. 2, 1998, to formulate consensus guidance for the February-April 1998 season in Southeastern Asia. The Bangkok Forum reviewed the state of the global climate system and its implications for Southeastern Asia. One of the principal factors taken into account is the major El Niño event ongoing in the tropical Pacific Ocean; anomalously warm sea-surface temperatures over the Indian Ocean were also considered. Recent El Niño occurrences such as in 1982-83, 1986-87 (although with somewhat different patterns), 1991-92 and 1994-95 resulted in below-average rainfall across much of Southeastern Asia and disrupted climate patterns around the globe.

METHODOLOGY

The regional climate assessment began with consensus agreement that the current El Niño will remain over the forecast period (February-April 1998). This and other factors affecting Southeastern Asia's climate were assessed using coupled ocean-atmosphere models, physically-based statistical models and expert interpretation. The current status of seasonal-to-interannual forecasting allows prediction of spatial and temporal averages, and does not fully account for all factors that influence regional and national climate variability. This Outlook is relevant only to seasonal time scales and relatively large areas, and local variations will occur. Users are strongly advised to contact their National Meteorological Service for interpretation of this Outlook and for additional guidance.

OUTLOOK

February through April covers much of the dry season in most parts of the Asian tropical monsoon region, with April being the transitional month of the commencement of the summer monsoon. The region from the Philippines, northeastern Kalimantan, northern Sulawesi, most parts of Indochina, Thailand, Myanmar, Bangladesh and Sri Lanka are expected to continue to have below-average precipitation, except for southeastern China and the western part of Sumatra, where there is an expectation of above average rainfall.

The precipitation outlook described above is consistent with conditions in Southeastern Asia and the Indonesian maritime continent usually associated with the mature phase of a major El Niño episode.

PARTICIPANTS

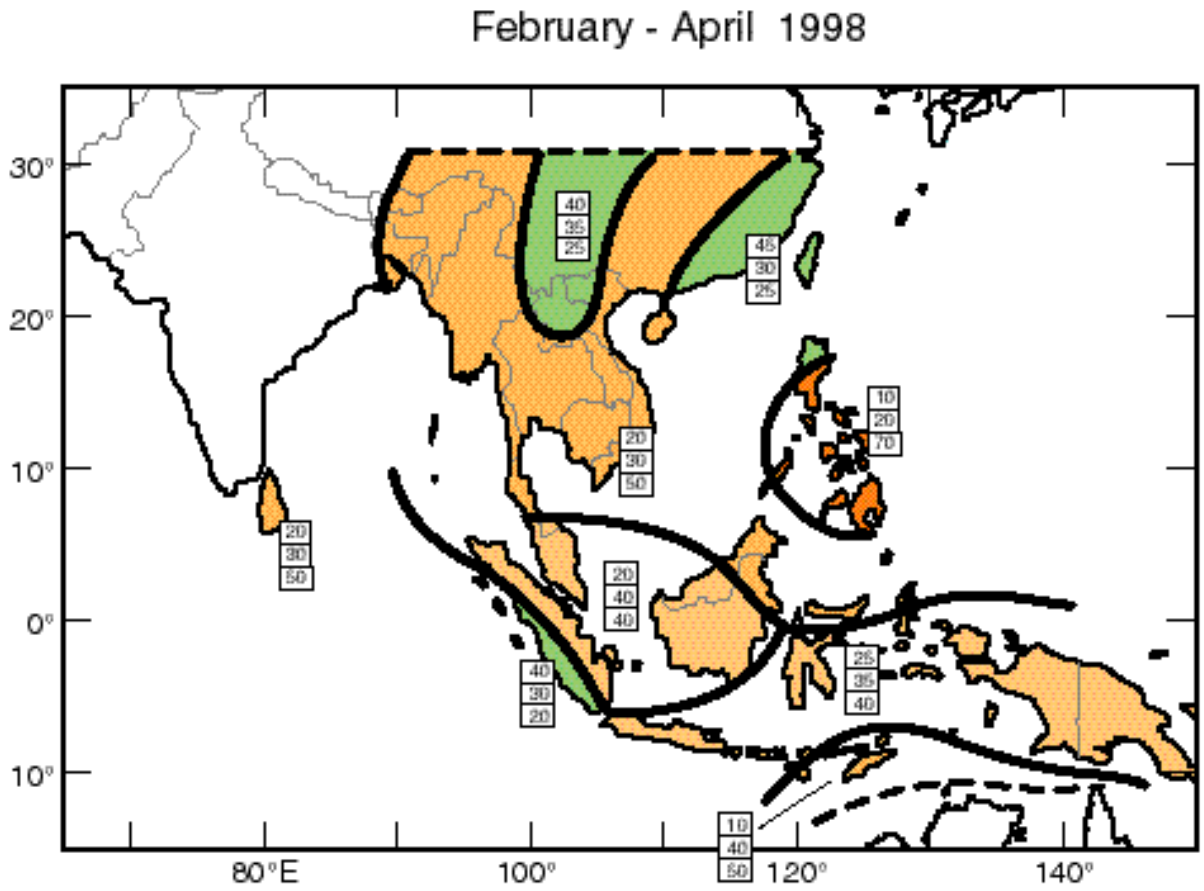
Participants at the Forum included representatives of fifteen Meteorological Services (Australia, Bangladesh, Kingdom of Cambodia, China, Fiji, Indonesia, Republic of Korea, Lao PDR, Macau, Malaysia, Union Myanmar, Philippines, Sri Lanka, Thailand and Socialist Republic of Vietnam) and climate scientists and other experts from national, regional, and international institutes (Asian Disaster Preparedness Center, IRI, the University of Colorado, NOAA, and USAID).

Consensus Climate Guidance

Southeastern Asia Regional Climate Outlook Forum

2 February, 1998 Bangkok, Thailand

(for list of participants and explanatory text see associated discussion)



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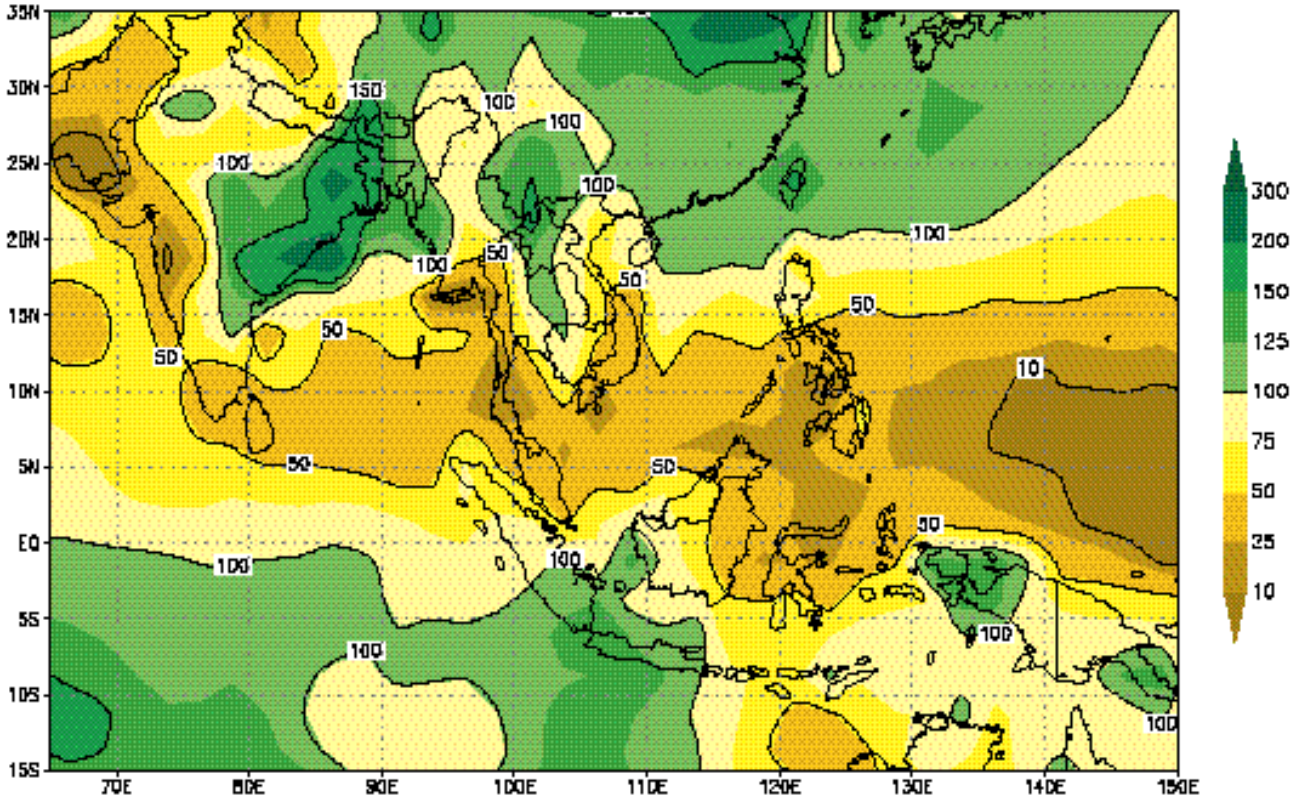

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Recommendations

The Outlook Fora were largely successful in achieving the objectives of 1) developing and communicating consensus seasonal Climate Outlooks, 2) facilitating research cooperation and data exchange within and between regions; 3) improving coordination within the climate forecasting community; and 4) developing a regular dialogue between producers and users of the climate information. In fact, several of the regions where the Outlook Fora occurred have already conducted or plan to conduct consensus climate forecast activities in 1998-99. These activities will further advance collaboration between climate forecasting entities and decision makers in climate-sensitive sectors.

Participants in the Outlook Fora and associated meetings identified priority activities for developing climate forecasting and applications techniques and closing the gap between user needs and forecasting capabilities, including:

- Improved forecast accuracy, detail, and tailoring for decision makers in specific sectors;
- Forecast training programs and educational opportunities that cross political and sectoral boundaries;
- Establishment of uniform criteria for forecast skill and validation techniques;
- Continued updates (ideally consensus forecasts) of the state of the climate for the upcoming season;
- Continued interaction between forecast users and producers to create the best and most applicable forecasts for given sectors; and
- Pilot demonstration projects designed to establish a framework for responding to climate forecast information in the areas of agriculture and food security, water resource management, public health, and forestry.

Many of these activities are currently underway or being developed by NOAA-OGPand its national and international partners that helped organize and fund Climate Outlook Fora in 1997-98.

Forecast accuracy and detail

While many of the forecasts for El Niño-related precipitation deficits or excesses were quite reliable and promising in their utility, they were by no means perfect. Further application of seasonal-to-interannual forecasts will be aided by improvements in their accuracy and detail. This will be achieved through continued physical climate system research into the dynamics of ENSO and other ocean/atmosphere interactions outside of the equatorial Pacific that have a significant influence on regional to global-scale climate patterns. Forecast detail will improve as computer models more accurately capture key climate system mechanisms and as computing power increases. In certain regions, forecasts based on historical data can be improved through compiling more complete and longer data sets of precipitation and temperature. Tailoring of forecast products to specific needs will also increase utility. For example, a forecast product describing the likelihood of extreme rainfall events may be more useful to a disaster manager than general seasonal precipitation trends.

Outlook Fora Methodology

Training

In some cases, lack of familiarity with seasonal climate forecasting or lack of capacity limited the contributions of participants to the Outlook Forum process. To support the development of climate forecasting and applications in the region, additional training and educational opportunities will be necessary. One possible model for training of forecast producers is the "Regional Training Course on Practical Application of Seasonal-to-Interannual Climate Prediction to Decision Making in Agriculture and Water Resources Management in Africa." The course, which was jointly sponsored by the IRI, the African Centre of Meteorological Applications for Development (ACMAD), and the WMO, occurred in Niamey, Niger, during the summer of 1997. Following the model of this course, a similar training session was organized by ACMAD, also in Niger, prior to the

PRESAO meeting in Abidjan, Ivory Coast, May 1998. The primary purpose of each was to expose a group of professionals from African countries who were familiar with seasonal and interannual climate variations and ENSO-related impacts, to state-of-the-art climate monitoring and predictions.

The first portion of the training courses focused on background of climate prediction, current models, data requirements, communications, model output interpretation, amalgamation of different data sources and regional problems associated with ENSO events. Participants learned how to use the software CLIMLAB, a statistical and graphical software package designed to analyze climate information, and to make statistical climate forecasts of past conditions (i.e., hindcasts) for their individual countries. Participants then used observational data from their country/region to validate the hindcast results. As a result of this training, national meteorological service participants at the West Africa Outlook Forum were better prepared to actively engage in the creation of the Climate Outlook. Also, the measured skill of their individual forecasts permitted a more objective blending of forecasts into a consensus.

Training courses such at those that occurred at ACMAD are an essential component in building regional capacity to utilize climate forecast information. Training and educational opportunities are also necessary for the user community to enhance understanding of the capabilities and limitations of forecast information. The IRI, WMO, World Bank, IAI, START, ACMAD, and other institutions, both public and private, have expressed their enthusiasm for participating in and contributing to the creation of cross-sectoral training and educational opportunities related to climate forecasting.

Forecast Criteria

The potential usefulness of climate forecasts depends upon their accuracy. It is therefore essential that common criteria be established for the creation and evaluation of forecasts. For the Outlook Fora, forecasters in various regions used a multiplicity of verification methods for their individual forecasts which were often difficult to compare. Ideally, all forecasts should be verified in terms of a standard set of criteria to provide a common measurement base that can be used to inform future development of techniques.

The following set of draft criteria are under consideration by the Southern Africa Climate Outlook Forum. Participants at SARCOF generally agreed that a set of objective criteria are necessary to govern the inclusion of individual forecasts which serve as inputs to consensus Outlooks. Criteria are necessary because it takes many years to prove whether, and at what level, a forecast system demonstrates skill. If adopted, all forecast contributors would be required to submit a summary of their forecasting systems, including methods and estimates of skill levels expected in real-time.

For empirical methods:

- Predictors should be physically plausible and based on current scientific understanding;
- Assessing the skill in real-time is controversial, but some estimate of skill independent of model training is needed;
- Satellite records are generally considered too short to be used in empirical models;
- Adata set of 30-40 years is considered necessary to derive reliable skill estimates; and
- A number of methods for testing skill levels are available, including cross-validation and retroactive real-time validation.

For dynamical models:

- In many cases validation cannot be performed due to an insufficient number of model experiments, but the general ability of a model to simulate atmospheric responses to sea surface temperatures contributes to confidence in the model's forecasts;
- Some estimate of skill is required;
- Ten years of past forecasts are preferred; and
- Each model should be treated on its own merits.

Establishment of a skill-verification system will help prospective users of climate information determine which forecast products best suit their requirements. The need to provide common verification methodologies across differing forecast systems has been recognized by the World Meteorological Organization Commission for Atmospheric Sciences Working Group (WMO-CAS), and an internationally-accepted standardized verification system (SVS) is currently being devised cooperatively by the WMO-CAS, the WMO Commission for Basic Systems (CBS), and the WMO Commission for Climatology (CCI). A training workshop linked to the Outlook Fora would be an ideal venue for exploring the practicality of using a common verification and validation methodology based on a common data set.

In addition to the issue of validating individual forecasts, the skill of the consensus forecasts created at the Climate Outlook Fora also need to be evaluated. One example of quantitative Outlook evaluation is the method employed by SARCOF participants.[34] Although this method does not fully address the probabilities associated with terciles, it is the type of quantitative and objective procedure necessary to avoid potential biases in qualitative evaluations. A major challenge to climate forecasters and users is to develop a validation technique for consensus forecasts that 1) more fully accounts for their probabilistic nature, and 2) provides a measure of skill that users of the forecast information can understand.

Outlook Communication and Dissemination

Terciles

The use of terciles and the term "normal" could be altered to provide the user with more detailed and clearer information. Although "normal" in the tercile scheme is defined as the middle third of the historical record, to a potential forecast user, "normal" is a subjective term that could result in expectations for climate conditions different than those originally forecast. One way to address this issue would be to provide forecasts in terms of probability that rainfall will exceed a given amount (e.g., there is a 70% chance that rainfall will exceed 20 centimeters over the next 3 months) or in terms of likelihood of extreme rainfall events. Using rainfall amounts would provide more information to the user while simultaneously avoiding subjectivity associated with the terms below-, near-, and above-normal. Alternatively, regional maps of threshold rainfall values for each tercile would also encourage users to think in terms of rainfall amounts as opposed to what is "normal." Such maps were handed out by the IRI at the Greater Horn of Africa Forum and the PRESAO. The maps were received favorably by NMHS representatives, but were difficult for users to interpret. Also, the multi-colored and intricate nature of the maps made them difficult to reproduce in many regions.

Communication Links

Communications and connectivity, particularly with regard to email and the internet, were recurring themes at the Outlook Fora that will have to be addressed in order to realize climate forecasting and applications goals. Communications capabilities differ greatly within regions among both the producers and users of climate forecast information. Vital communication links are supported by a range of technologies, from state-of-the-art internet connections to unreliable telephone and radio links. Collaboration between local, regional, and international entities will be vital to the development of improved communications links which will enhance the flow of information between forecast users and producers at a number of levels and across a myriad of sectors.

Systematic Forecast Creation and Distribution

The Climate Outlook Fora and associated meetings prior to and during the 1997-98 El Niño event demonstrate clearly the need and potential for a long-term strategy for the regular generation,

[34] See SARCOF Preseason Outlook evaluation section.

dissemination, and application of forecast information. To meet this challenge, NOAA-OGPis working in Africa, Latin America, the Caribbean, and Southeast Asia, with a group of domestic and international partners, to develop regional forecast production and application capabilities. In Latin America and the Caribbean, for example, NOAA-OGP is working with USAID-OFDA, WMO, IRI, and several international and national level organizations to establish the Pan-American Climate Information System (PACIS). An agreement signed by the governments of Chile and the United States at the Summit of the Americas in Santiago (April 1998) formally recognized the intent to establish PACIS. It is envisioned that such a system will be capable of monitoring, modeling and predicting climate and then interpreting and applying climate predictions for the making of mitigation and response policies and decisions. This comprehensive approach will serve to build on and coordinate a range of activities currently being carried out in the region.

Creating systematic mechanisms and activities for climate forecast creation and dissemination will build on existing regional institutions and capacity, therefore enhancing the potential for the system to be maintained and further sustained with regional resources. The intended result will likely be a regular, ongoing series of climate updates, distributed to sectoral specialists and the public through National Meteorological and Hydrological Services and by other media, that would improve decision making in the context of climate variability. Sector-specific activities would be undertaken to mitigate the impacts of predicted extreme climate conditions on vulnerable populations, as well as to enhance sectoral performance under benign or beneficial conditions.

Forecast Value

The identification and monitoring of user activities in response to forecast information products and an estimation of the benefits obtained by selected users is an essential component of forecast applications. Through successful application of climate projections, users will be more inclined to incorporate forecasts into their decision making processes. Many of the participants of the Outlook Fora were surveyed to determine the value of the climate forecasts. Value, like the term normal, is a subjective one, and therefore difficult to measure. Evidence is often anecdotal, and determining what would have happened in certain instances had a forecast not been utilized is problematic. Nonetheless, survey results from climate forecast users in southern Africa, Latin America, and the Caribbean indicate that the Outlooks, although not perfect, were useful to many individuals in planning for and responding to climate variability associated with the 1997-98 El Niño.